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EOS SPHERES

Institute for the Study of Earth, Oceans, and Space • A University of New Hampshire Research Institute • Morse Hall, Durham, NH

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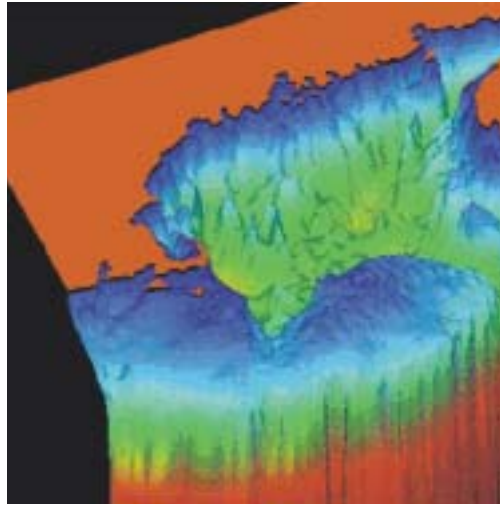
Vol. 1 Issue 3

As COAA is kicked-off, EOS scientists are also helping develop a new ten-year project sponsored by IGBP and SCOR (Scientific Committee on Oceanic Research). The Ocean Biogeochemistry and Ecosystems Analysis – OCEANS – program will examine the sensitivity of the ocean to global change. Planning for OCEANS will continue at an Open Science Meeting in Paris this January. Plan to attend and help shape the future of ocean research! <http://www.igbp.kva.se/obe/>

Celebrating Excellence

An "EOS-ian" approach to Ocean Observing

Scientists gather data, and as human beings we seek understanding, but the two are not always the same thing. The newly established UNH Center of Excellence in Coastal Ocean Observation and Analysis (COOA) will ensure that data gathered by the multitude of scientific observations of the ocean system will be turned into information and understanding that can lead to appropriate action.



This bathymetry image shows the topography of the sea floor in the Gulf of Maine, the region of focus for COOA. Photo by P.H. Wiebe, WHOI

Ann Bucklin, co-director of EOS's Ocean Processes Analysis Lab (OPAL) where COOA is based, explains the need for information, "Most people don't understand the meaning of data, such as the amount of primary production recorded on a particular day, and managers can't necessarily use data to make decisions. Data, the raw material of understanding, is good, but not the end product."

The Ocean Observing Systems - networks that systematically acquire and disseminate ocean data - have gained importance because of the unknown consequences of human activities and climate change on the ocean. COOA will take advantage of the subsequent amount of high quality data being gathered in order to increase our knowledge about the health and future of the coastal ocean.

The Center will host a long-term effort to synthesize coastal ocean data to eventually predict events such as harmful algal blooms. Also, COOA will locate and use data from many sources, including data not necessarily intended for the problem being addressed.

"Frequently, scientists collect data that are useful to answer questions that they were not seeking answers to," says Bucklin. "COOA will make sure these data are available for researchers who seek answers to new questions."

Some of the first tangible signs of the Center's work will include Gulf of Maine primary production maps derived from satellite data and improved on-line management of other ocean research data through the creation of WEB-Coast. This data server will be based on WEBSTER, EOS's on-line Earth science data warehouse which has traditionally focused on terrestrial data.

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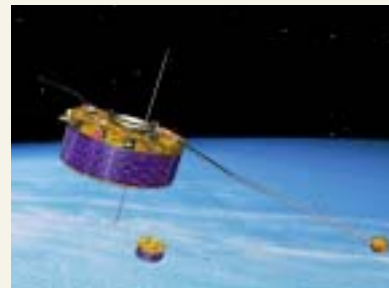
Unraveling the Mysteries of Space

To study the interaction of the sun with Earth, space scientists are faced with a very tough challenge; they must understand what comprises a 100,000 km² area of space between the Earth and sun and a radius at least ten times that amount away from the Earth in every direction. This entire area is called the "magnetosphere," and it is full of charged and neutral particles that hold the key to knowledge about our part of the galaxy.

Roy Torbert, Director of the EOS Space Science Center, and his colleagues are getting one step closer to unraveling some of the mysteries held in the magnetosphere with a recent grant award from NASA's Sun-Earth Connections Program. Torbert's award of \$495,000 will go towards developing a model of a small satellite.

Torbert is interested in learning about magnetospheric storms, which cause auroras. Storms in space occur over a large area and are therefore difficult to study with the typical instrumentation used to study other, more local, space phenomena. To study storms,

continued on page 2



The CLUSTER mission (pictured) involves four satellites. Magnetospheric storms will be examined using 50 to 100 satellites, which are being designed by Torbert and colleagues.

asdfghjk



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Institute for the Study of Earth, Oceans, and Space (EOS)
Morse Hall, Room 309
39 College Road
Durham, New Hampshire 03824
Tel: (603) 862-5369
Email: amy.seif@unh.edu

www.eos.unh.edu

Director: Berrien Moore III
Associate Director: David Bartlett

Editor: Amy Seif
Graphic Designer: Kristi Donahue
Circulation: Clara Kustra

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Unraveling the Mysteries of Space

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Torbert is faced with a fascinating problem, the root of which is described below.

Says Torbert, professor of physics and EOS, "Our satellites normally acquire data at a single moving point, and we try to make a conception of the global picture by utilizing repeated observations. However, it is hard to tell from these single points whether anything has changed over time. Imagine that you were trying to tell what was in a dark room using only the tip of your finger. What if things are changing in time? One solution is to have many different people's fingers feeling around the room simultaneously and comparing their different observations."

This dilemma has been partially solved in the realm of space science through the deployment of a few satellites to study narrow boundaries, such as the CLUSTER mission which includes four satellites. But for global storms in space, a few points are not enough. The study of storms calls for 50 to 100 satellites, which, according to Torbert, "is a lot of mass and money."

With colleagues from Austria, Germany, Texas, and Boston, Torbert will be identifying the minimum power and mass needed and locations for 50 satellites, each of which is exactly like the other. -AS

From the Director

Reflection upon the Year

A few weeks ago, I spoke at the Forum on Science and Technology within the World Summit on Sustainable Development in Johannesburg. This was an extraordinary meeting in its complexity, in its political diversity, and in its scope. It also provided extraordinary challenges to an American.

Needless to say, there are profound scientific and social obstacles blocking the path to sustainable development; however, I believe that EOS is well positioned to help forge the trail through many of these barriers.

A central scientific challenge is to determine the link between the Earth's biogeochemical (metabolic) system and physical-climate system. Present understanding is incomplete and will require extensive interdisciplinary collaboration. It will also require global data that clearly documents the state of the system and how that state is changing, as well as observations to more clearly illuminate important processes. Meeting this scientific challenge has been at the core of EOS's broad Earth and environmental science agenda since its inception; EOS has demonstrated that we excel at the needed multi-disciplinary and multi-national scientific strategy. Moreover, by advancing our understanding of the Sun-Earth system, our EOS colleagues in the space sciences set the fundamental baseline for the

planet's climate-biogeochemical system.

In EOS, there is a record of helping to build scientific capacity around the world. This is critically important. Ten years after Rio, a major obstacle to sustainable development for much of the world remains the lack of scientific and technological capacity, particularly in developing countries. It is essential to develop a critical mass of capacity in all countries. An important hallmark of EOS is its ability and predisposition to partner successfully with colleagues from all regions of the planet; it is also a distinctive aspect of our graduate program.

The issue of sustainable development poses significant challenges, but they are not insurmountable. The challenges to understanding the Earth system including the human component are daunting; the pressing needs are significant; the mountain top of sustainable development is high and, as yet, has not been scaled. However, the opportunity for progress exists, and, in fact, this opportunity must be realized. The issues are too important, and they will not vanish. The challenges simply must be met. - Berrien Moore III



An "EOS-ian" approach to Ocean Observing

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Explains Bucklin, "This partnership immediately puts COOA in the lead because we have the WEBSTER database and data serving capacity."

Established with a \$2 million award from the National Oceanic and Atmospheric Administration as part of the Coastal Observation Technology System (COTS), the new Center will begin with five seed projects. EOS and Earth Sciences Professor Janet Campbell, co-director of OPAL, was recently appointed as the Director of COOA.

Says Campbell, "What makes COOA different from other funded research projects is not its focus on coastal ocean observations. Most of the OPAL faculty already do this. What is different is that we are now stepping up to the challenge of delivering information derived from the data we collect to a much broader community. One of the first steps will be to identify the user communities that we hope to serve, and then learn what their information needs are."

EOS scientists with expertise in a core discipline underlying coastal ocean observation and analysis will lead four of the projects. The Advanced Polymer Lab in the Chemistry Department will also take on a project. These projects will include field observation and data collection in the Gulf of Maine; managing, serving, and manipulating real-time and retrospective data; and new technological developments for ocean sensor designs. These investigations will be linked to other COTS programs and will provide the template for the university's participation in the COTS federation of projects.

"We are bringing an 'EOS-ian' approach to ocean observing," states Bucklin. "At EOS, we study the ocean system from physics to fish. We will use COOA as an opportunity to assume a leadership role in data integration and analysis, filling a critical need for information and information products in the coastal ocean." - Amy Seif

<http://www.COOA.unh.edu>

Uncovering the Amazon

The largest-ever environmental science conference in the Amazon took place this July in Manaus, Brazil. The over 500 participants at the 2nd International Large Scale Biosphere Atmosphere Experiment in Amazonia (LBA) Scientific Conference included more than seven EOS scientists. One of these scientists was Michael Keller of the USDA Forest Service, also the U.S. lead scientist for LBA, who is a guest investigator in EOS.

Says Keller, "EOS had a big participation, which is not surprising since it is a premier institute for Earth System Science - from remote sensing to process studies. LBA looks at the role of the Amazon in the Earth system. The philosophy of LBA and EOS are very similar, which is why my office is here. It is such a good fit."

Although Keller is housed at the Institute, LBA is an international program led by the government of Brazil. Funded in-part by NASA and the European Union and sponsored by Brazil's Ministry of Science and Technology, the program studies the role that the Amazon forest plays in the planet's life support system. No other scientific endeavor takes such an ambitious, interdisciplinary look at the Amazon's role in large ecological phenomena, such as climate change.

Keller explains that, with the help of EOS scientists, "We are slowly coming to a conclusion that the Amazon is close to neutral as a source or sink of carbon dioxide, and that it is highly unlikely that old growth forest can be a significant carbon sink despite earlier claims." -AS

<http://www.lba.br.unh.edu>



Michael Keller (taking notes) and Brazilian Elivan Oliveira Santos measuring a fallen tree at a recently logged site in Tapajos, Amazonia. Photo by Jeff Hicke

They Come Back for More

Every three years since 1980, a competition has taken place for funding from NASA's Sun-Earth Connections Theory Program. Each time, the UNH's Solar-Terrestrial Theory Group has emerged as a winner.

This year proved no exception, as the group received another \$1.2 million over three years to fund its investigations of phenomena produced by the sun. Another half million dollars annually from other NASA and NSF programs provides funding to the group, as well.

Joseph Hollweg, professor of physics at the Institute and lead member of the group, explains, "Why do we continue to receive this award when there are a lot of other bright people out there? Simply put, the group is working on relevant problems and we've made significant progress."

In the realm of space science, the group's members are considered leading experts on coronal studies, solar wind and cosmic rays, and have consistently progressed over the 22 years of their pursuit to understand these processes. In this time, they have turned around disbelief in the scientific

community and have been the first group to investigate what are now the leading theories for several solar phenomena that have been mysteries for decades.

For example, they found that waves generated along magnetic fields cause the sun's atmosphere to get exceptionally hot, which in turn enables winds of gas to escape from the sun. "For a long time people didn't believe our theories for heating the corona and accelerating the solar wind," says Hollweg. "The surprise came in 1995 when the SOHO satellite came up with data which verified our predictions."

Regarding his own interest in this kind of research, Hollweg responds, "It is like solving a puzzle. The questions we are asking, such as what makes the corona hot, are no different then asking what makes the sky blue."

EOS's Solar-Terrestrial Theory Group includes Hollweg, Martin Lee, Terry Forbes, Philip Isenberg, Bernard Vasquez, Yuri Litvinenko, and Sergei Markovskii. -AS

<http://www.sttg.br.unh.edu>

Bookmark this

A New Window Opens

The door to a service previously utilized mainly by professionals has opened, enabling access to Geographic Information Systems (GIS) maps and related data by anyone with a web browser. EOS's GRANIT, a statewide GIS clearinghouse, holds information on over 1.3 million acres of conservation lands in New Hampshire. A new application called the "Conservation Lands Viewer" enables non-GIS savvy citizens the ability to view maps showing the location of land parcels forever protected from development. All visitors to the GRANIT site can now generate and print maps of conservation areas, as well as access topographic maps and aerial photography.

<http://www.granit.br.unh.edu>



P.A.T. Her on the Back

For her outstanding performance and distinguished service to the university, Fay Rubin, GRANIT Coordinator in the Complex Systems Research Center, was awarded a UNH Presidential Award of Excellence. This annual award goes to two professional and technical (PAT) staff members who have completed at least three years of service to the university. Way to go Fay!

Faculty/Staff News

Earth System Science

George Hurtt and his research colleagues have become the lead in coordinating very high resolution IKONOS remote sensing data in the LBA. Hurtt was recently asked to serve as a member of the Editorial Board of the international journal *Ecology Letters*.

As a guest scientist, Changsheng Li participates in a large-scale project, funded by the European Union Commission, focusing on greenhouse gas emission studies at 14 forest stations in nine European countries. This project has arisen out of a five-year collaboration between UNH and the Fraunhofer Institute for Atmospheric Environmental Sciences in Germany.

Scott Ollinger's paper, titled "Interactive effects of nitrogen deposition, tropospheric ozone, elevated CO₂, and land use history on the carbon dynamics of northern hardwood forests," recently appeared in *Global Change Biology*. Ollinger and Mary Martin spent much of the summer traveling between North Carolina, Florida, Maine and Massachusetts shooting leaves out of trees for a NASA carbon cycling project.

Cameron Wake reports that the 2002 season of the Eclipse ice core drilling program in the Canadian Yukon was very successful. Wake and his research team recovered a 345 meter ice core from their main hole and a total of 190 meters of ice core from three other holes.

Karen Von Damm was recently awarded a scholarship to the 2002-03 HERS Management Institute at Wellesley College. UNH awarded three scholarships to this annual program for female staff and faculty in management roles.

On the eve of the 2002 United Nations Earth Summit, Charles Vörösmarty and the Water Systems Analysis Group were referenced in several national press articles on global water shortage in *National Geographic*, the *New York Times*, and *Science News*.

Space Science

The International Gamma-Ray Astrophysics Laboratory (INTEGRAL) is being used to make an observation requested by Mark McConnell, who will analyze the data to study an unusual source first seen with the Compton Gamma Ray Observatory. McConnell recently had a paper accepted in *Solar Physics* describing the work he is doing as a guest investigator on RHESSI.

A recent grant award of \$597,561 for 3 years from NASA's Sun-Earth Connections Instrument Development Program will support the development of a new image tube readout device, making the SONTRAC neutron detector better suited for a future flight in space. Richard Miller is the principal investigator.

Eberhard Möbius was the main scientific organizer of the symposium "To the Edge of the Solar System and Beyond" at the World Space Congress in Houston this October and was an organizer for the plenary panel discussion on "A Vision for the Next 25 Years in Space Science." He also participated on a panel discussing arts in science and education at the "Arts in Education Conference," sponsored by the NH State Council of the Arts.

We're Growing

The Institute is in the midst of an important stage of growth that is significantly expanding EOS's research capability and scope. By the end of this academic year, faculty numbers will have grown by twenty percent in two years.

David Bartlett, Associate Director of EOS, explains, "Beyond replacing faculty who have left, we are enlarging and broadening the scope of our two smallest centers. We are also filling in areas that complement the existing expertise in our other centers."

One growing research area at the Institute is the Atmospheric Investigation, Regional Modeling, Analysis and Prediction (AIRMAP) project. Three new faculty, Huiting Mao, Alex Pszenny, and Barkley Sive (pictured) have already arrived and contributed to the project, and Robert Griffin is due to arrive this winter.

Robert Talbot, Director of the AIRMAP Cooperative Institute and the Climate Change Research Center, explains, "With the recent growth in faculty, AIRMAP is becoming a diversified research initiative and beginning to play a leading role in the air quality community. We've obtained expertise in some of the most critical areas for understanding air quality in New England."

In the Space Science Center (SSC), new faculty will build upon the center's prominence in the field. Three new faculty (pictured), James Connell, Bruce McKibben, and Clifford Lopate, have come as a coherent group from the University of Chicago. Their work in studying the interaction of cosmic rays with the solar wind and interplanetary magnetic field puts UNH among the top in solar physics. The SSC has also grown as internal promotions have created faculty positions for Charlie Farrugia and Yuri Litvinenko.


Explains Roy Torbert, Director of SSC, "The addition of the Chicago group and the Peter Paul Chair of Space Science, yet to be hired, will provide the Center with vital new research thrusts to complement and expand our thriving activities and allow us to compete for upcoming space missions with new capabilities."

While the SSC builds out farther into the reaches of the universe, the Ocean Processes Analysis Lab (OPAL) is now exploring more facets of the ocean. Jeffrey Runge, a biological oceanographer, Jamie Pringle, a physical oceanographer, and

biogeochemist Amala Mahadevan are recent additions, with more new arrivals on the horizon.

"At one time we had one of each kind of oceanographer," remarks Janet Campbell, co-director of OPAL. "Today our specializations are much more overlapping and thus conducive to collegial interaction and research collaborations. This is evident in the number of successful proposals in which our faculty are co-investigators."

New faculty are bringing more interdisciplinary opportunities to EOS and UNH, including Mark Fahnestock (pictured), who bridges both climate studies and water systems analysis, in the Complex Systems Research Center, which also recently welcomed Erik Hobbie. These strengthened areas of collaborative research are leading EOS into new and exciting explorations, and thus opening up areas of potential graduate study.

"Growth in numbers and reputation places the Institute in the forefront of academic centers conducting interdisciplinary research and education in Earth and Space Science," says Berrien Moore III, Director of EOS. "We have been truly fortunate in having scientists with international distinction join our efforts." -AS 



New faculty, from top to bottom: (on left) Research Associate Professor Mark Fahnestock, Research Associate Professor Barkley Sive, (on right) Research Associate Professor Clifford Lopate, Associate Professor James Connell, and Research Professor Bruce McKibben.



Student Profile

Going the Distance

When he's not out rock-climbing with his hands pressed firmly onto the Earth, Lukas Saul, a Ph.D. candidate in physics, is thinking about the far reaches of outer space. He studies interstellar matter that, when passing through the sun's atmosphere, becomes charged and gets picked up in solar wind.

"I like that we're measuring something from outside the sun's atmosphere," says Saul. "Pick-up ions are not just extra-terrestrial, they are extra-solar and perhaps primordial. Their source is further away from us than has ever been directly measured."

Saul's research has several important and tangible applications, which is why NASA awarded him a Graduate Student Research Fellowship last year. Saul is using data on pick-up ions from the SOHO and CLUSTER missions to help understand the solar wind, material coming off the sun at high speeds that can affect satellites, cause auroras, and bring about power grid failures here on Earth.

Pick-up ions can undergo acceleration, heating, and other transport processes in the solar wind

plasma environment. Explains Saul, "We're basically studying space plasma. If we can understand plasma a little better, maybe we can make a fusion reactor."

"I like studying such tenuous media, something that is almost nothing," says Saul. "I feel my research allows me to be more in touch with the fields of space and time itself. It stretches one's mind beyond what we are used to thinking about here on Earth."

Saul credits his advisor, Eberhard Möbius, professor of space physics at EOS, for originally giving him the idea to study pick-up ions. Saul illustrates his relationship to his advisor with a joke about a rabbit that is doing a thesis on the superiority of rabbits over wolves. When a wolf comes by to eat the rabbit, the rabbit first brings the wolf into his house to prove his thesis. The rabbit comes out alone, and later it is revealed that there's a lion inside the house.

Saul explains, "The moral of the story is that, as a graduate student, it is not so much about having a good thesis, it is about having a good advisor." 🌍



Lukas Saul, doctoral candidate in the Space Science Center, takes a break from studying to smile for the camera.

Student Recruitment

A Summer of Discovery Continues ...



Thomas Daigle, now a senior at Union College, spent his summer in a freezer, and he is coming back for more. In fact, all of the students who participated in this past summer's Research & Discover internship program at UNH are continuing their research over the year and into next summer. This new program for college juniors, sponsored by NASA and UNH, is celebrating a successful first year that went beyond initial expectations.

Catherine Denoncourt (pictured), a senior at UNH who also is now no stranger to cold environments, spent part of her internship on top of 3200 m of ice. "Going to Summit, Greenland to do atmospheric chemistry research was so much more incredible than I thought it was going to be," said Catherine, who describes this internship as the "most incredible experience" of her life.

Each student worked with a faculty advisor from EOS. Daigle didn't mind spending a lot of time in the research freezer, because there he was given the unique opportunity to look at 76 years of Earth's history captured in an ice core drilled by his advisor, Professor Cameron Wake. Heather Bain, from College of the Holy Cross, learned about a warmer environment during her trip to Brazil with Professor George Hurtt to collect field data on forest fires and develop ecosystem models. Bill Sacks from Williams College is teased in good fun because most of his summer was spent behind a computer, but Sacks is the first one to say he would recommend this program to a friend.

"In fact, I just did," said Sacks. For his senior thesis, he will be continuing to test an ecosystem model, which he developed with the assistance of Professor Rob Braswell.

A highlight of the summer was a trip to NASA-Goddard, where the students presented their work to NASA scientists. The program will continue next summer, when these same students will have the opportunity to work alongside scientists at NASA, and it will culminate in possible fellowship offers to graduate school at UNH. -AS 🌍

Apply to next year's R&D Program at

<http://www.eos.sr.unh.edu/ResearchAndDiscover>

Student News

Jeanne Anderson, a Ph.D. candidate, was awarded a fellowship from the Switzer Foundation last spring to support her work on the conservation of forest ecosystems through the application of remote sensing to questions in conservation biology and ecology. The Switzer Environmental Fellowships are among the nation's most prestigious awards for early-career environmental leaders.

The paper entitled "Projecting Future Fire Activity in Amazonia" by Manoel Cardoso, a Ph.D. candidate, has been accepted for publication in *Global Change Biology*. The paper presents a new fire model used to project fire activity in response to potential changes in land-use and climate in Amazonia.

Amy Frappier is first author on a paper published in *Science*, titled "Stalagmite carbon isotopes record El Niño events." Frappier and her advisor, Dork Sahagian, found a correlation between stable carbon isotopes recorded in stalagmites and El Niño events suggesting that ecosystems can amplify weak local climate signals.

Beginning this February, Rachel Gallant, a Ph.D. candidate, will spend a year in Washington, D.C. working with a legislative branch office of the U.S. government. Gallant was awarded a Dean John A. Knauss Marine Policy Fellowship, a program of Sea Grant (see "Sea Grant News").

Seung-Hyun Son, a Ph.D. candidate, was awarded an International Ocean Colour Coordinating Group fellowship, which enables him to spend two months at the Bedford Institute of Oceanography in Halifax. He will receive training on the primary production model using ocean color remote sensing for coastal waters. Seung-Hyun's other news includes passing his qualifying exams, and he is giving a presentation at the "Ocean Optics XVI meeting" in Santa Fe this November.

In the Wake of the RV Ronald Brown

On a hot, sticky day in July, the Research Vessel Ronald H. Brown provided the backdrop for an announcement by UNH President Ann Weaver Hart that U.S. Senator Judd Gregg (R-N.H.) had included \$12 million in funding for Northeast air quality studies in a Senate appropriations bill. EOS's Atmospheric Investigation, Regional Modeling, Analysis and Prediction (AIRMAP) project is slated to receive \$5 million.

This announcement came in the midst of the 2002 campaign of the New England Air Quality Study, an effort of more than 20 partner institutions to identify why the northeastern U.S. has some of the worst air quality in the country. This study was funded by the National Oceanic and Atmospheric Administration (NOAA) and partially initiated by AIRMAP, which monitors air quality through four research stations around New Hampshire. This summer's month-long campaign included additional mobile platforms.

The RV Ronald Brown, NOAA's largest research vessel, was essential for gathering information on sea breeze. A G-1 Gulfstream aircraft, operated by the U.S. Department of Energy's Pacific Northwest National Laboratory, flew above urban sites to gather data on air quality in source cities and studied the vertical and geographical distribution of pollution.

Alex Pszenny, research associate professor of EOS with a joint appointment at the Mount Washington Observatory, sums up the study saying, "This campaign allowed the best characterization of the processes that control air quality over New England coastal waters that has ever been obtained."

"The conditions this summer were quite good for air pollutant sampling, offering us better than expected meteorological and chemical conditions

for data collection," says EOS and Earth Sciences Professor Robert Talbot, Director of the AIRMAP Cooperative Institute.

Currently, the gathered data is going through a quality check, to be released to the study's partners in January. While it is too early to make claims about findings, in general the study has offered a better understanding of the influence of sea breeze on air quality in New England. Also, there is some indication that the models for ozone, developed previous to the campaign, can provide realistic simulations of the ozone spatial distribution but not as good representation of the temporal trends.

Another less tangible, but valuable, outcome of the campaign was the strengthened partnership between NOAA and UNH. The two institutions are already busy planning for the much larger 2004 campaign to study New England's air quality. NASA's Global-Tropospheric Experiment, which utilizes a DC-8 aircraft known as "one of the premier research aircraft in the world," will have a large role in the next campaign.

For the New England-based scientists, this summer's study was personally meaningful. Pszenny explains that he could see his home town from the ship, and says, "After 20 years of studying atmospheric chemistry all over the world, I was able to do it literally in my own front yard."

At UNH, access to the data gathered by AIRMAP and other information about New England's air quality, is in our front yard. A museum-quality display on AIRMAP greets visitors to UNH's Dimond Library. -AS

<http://airmap.unh.edu>



The Research Vessel Ronald H. Brown during a brief stop at the Portsmouth Port Authority Pier.

Space Grant News

Participants pondered "How can you teach about Napoleon's demise without relating it to El Nino?" and other, more serious questions at this August's Space Grant workshop on preparing students for careers in remote sensing. Speaking to a full room at the New England Center, David Bartlett, Associate Director of EOS and Director of the NH Space Grant Consortium, welcomed 46 teachers, scientists, and industry representatives from as far away as Hawaii.

"Remote sensing data and information used to be produced and controlled by a few national governments, but now there is a large and growing industry," he explained regarding the value of imparting knowledge of remote sensing to students.

"This is a great forum for developing new educational requirements that are beneficial to students, government, and industry," noted Mark Brennan, a participant from Space Imaging, a major remote sensing company.

Remote sensing, which "models the embodiment of human knowledge of the Earth system" according to one participant, is a relatively new tool utilizing space and airborne sensors to study the Earth from space.

While most people have some exposure to remote sensing at a basic level, such as watching storms with weather satellites, one challenge is to move people higher in their understanding. A more specific challenge is to provide appropriate background for college graduates who may be employed in this growing field.

Working groups developed strategies to address these and other challenges, and a report from the workshop is being prepared for the NASA Earth Science Enterprise Program. -AS

Space Grant's web site is sporting a new look and updated information. Visit <http://www.nhsgc.sr.unh.edu> for scholarship and fellowship information, to find out about news and events, and to learn about the program.



UNH President Ann Weaver Hart announces new funding for AIRMAP. Also pictured (left to right): EOS Director Berrien Moore III, U.S. Senator Judd Gregg, NOAA Assistant Secretary of Commerce James Mahoney, and Professor Robert Talbot.

Sea Grant News

Every February some of the brightest graduate students in the nation pack their bags for Washington, D.C., to learn how national policies affecting marine resources are shaped. They are recipients of the Knauss Marine Policy Fellowship, a one-year paid fellowship that matches students who have an interest in ocean, coastal and Great Lakes resources with hosts in the government. The fellowships are sponsored by NOAA's National Sea Grant College Program; each fellow is nominated by one of the nation's 30 Sea Grant programs.

Heather Benway (MS, '97), an EOS and Earth sciences student of Professor Ted Loder, was selected as a 1997 executive branch fellow at the NOAA Office of Global Programs. She worked closely with the NOAA Paleoclimatology Program. Her fellowship turned into a job with NOAA, and she is now pursuing a doctorate in paleoceanography.

"The fellowship was an extraordinary experience for me. This fellowship removes students from the focused world of academia and places them at the forefront of science policy," says Benway.

This year Rachel Gallant, an EOS and Earth sciences student of Professor Karen Von Damm, has been selected for a legislative branch Knauss fellowship. Legislative fellows help to move marine-related legislation through Congress.

"Fellowships are intense learning experiences and I am really excited about this upcoming year," says Gallant. "I've had a longstanding interest in public policy and applying scientific knowledge to society in practical, sustainable ways."

For more information, please contact Ann Bucklin at 862-0122 or ann.bucklin@unh.edu.

—Kathleen Schmitt, Sea Grant

<http://www.seagrant.unh.edu>



Heather Benway performing a biodiversity survey in the Florida Keys during her year as a Knauss Fellow.

Faculty Profiles

Seeing the World in a Rain Drop



Charlie Vörösmarty Photo by Doug Prince, UNH

Charles Vörösmarty, Director of EOS's Water Systems Analysis Group, likes a good challenge; he's out to uncover how people are impacting watersheds all over the world. Every water issue experienced at the local scale, according to Vörösmarty, accumulates into regional and global scale problems.

"Global scale research originally interested me as a challenge," recalls Vörösmarty. "Our original proposals to develop geospatial models of terrestrial ecosystem and water dynamics over entire continents were met with great skepticism. Well, we forged ahead, building such a model for South America. A whole cottage industry sprung to life."

Vörösmarty and his research group still work in South America, studying how human action impacts water supply, but additional research now stretches from the Arctic to Africa. Recently, the group has become interested in signals of climate change in remote places like Alaska. Regardless of all his travels, Vörösmarty still has one foot on home base, with research sites in the Gulf of Maine.

"Whenever I have the occasion to travel," says Vörösmarty, "I see the same kinds of issues cropping up. From Arizona to Africa, wells are being depleted by a shocking amount each year. My motivation as a scientist is to connect the dots, sort of like painting by number."

On the professor's laptop is an image of a patchwork of artwork. The program allows you to zoom away from the original image, which makes the artwork smaller and smaller until a colorful map of the world appears composed of a mosaic of tiny pictures. Vörösmarty explains, "Studying global change gives me the opportunity to paint the tapestry." —AS

Brick by Brick

When Jack Quinn, research associate professor of EOS and physics, takes on a project, his dedication to it doesn't falter. Quinn has been deeply involved in the development of the Electron Drift Instrument (EDI) ever since he was a graduate student in the seventies, when he and his colleagues first proposed the instrument.

For 14 years following graduate school, Quinn worked at Lockheed Palo Alto Research Labs, where he worked with investigators who have been active since the beginning of the space age. There, he led the development of the sensor portion of the EDI, which measures the motion of the electrons and ions in space plasma.

Quinn explains, "EDI measures how particles move in space by detecting the motion of a beam of electrons. It's like dropping a stick in a river to see how the water is moving."

In 1995, a year before CLUSTER, which would carry EDI into space, was to be launched, Quinn left industry and joined his longtime collaborator, Roy Torbert, at UNH to prepare for the instrument's operations in space. Together, they watched on television as the rocket carrying the four CLUSTER satellites blew up shortly after launch. The story ends well however, with a successful launch four years later.

"I gave a 1979 presentation at the American Geophysical Union meeting on the instrument," says Quinn. "Now it is finally being used."

Quinn also has his feet planted firmly in the Earth; he was recently elected to the local school board, where he is involved in a broad range of Earthly issues, including the renovation of the high school that one of his daughters attends. —AS



Jack Quinn photo by S. Milovina



Institute for the Study of Earth, Oceans, and Space
Morse Hall
39 College Road
Durham, New Hampshire, USA 03824-3525

800280



New EOS Courses

Spring Ahead

Remote Sensing of the Terrestrial Biosphere

Learn analytical methods for using regional-to-global scale remote sensing data to study terrestrial ecosystems and the biosphere. Students are expected to develop a physically based understanding of global remote sensing data and gain experience to form and test hypotheses about Earth system processes. (Xiao, Braswell)

Concepts in Dynamical Earth System Science

The first part of this course covers geophysical processes and modeling common to all dynamical Earth System research. The second part consists of two separate tracks, of which students choose one, to cover dynamical concepts pertinent to sub-disciplines in meteorology and biogeochemistry. (Prentice, Frolking, Mao)

Climate and Fisheries

Students will examine biological and physical processes controlling recruitment and plankton productivity, climate-mediated changes in the ocean monitoring programs for oceanographic data, examples of climate-zooplankton-fish linkage, modeling approaches and management strategies. (Runge)

Syllabi for these spring semester classes are available at <http://www.eos.sr.unh.edu/Grads/Courses>

EOS Events

The Fall Concert Series

Celebrate the magic of a New England fall with mulled cider and the delightful sounds of live music filling the Morse Hall atrium. At EOS, fall brings the anticipated return of the Spheres Concert Series after its summer hiatus. Concerts take place from 12:15 - 1:15 p.m. on the third Thursday of each month of the academic year and are free and open to the public.



The series began in September with "The Virtual Consort," an award-winning archguitar duo. Heard on Public Radio's "A Prairie Home Companion," the group was picked from hundreds of entries to perform live on the show. Back by popular demand, the Piscataqua Chamber Players returned to Morse Hall on October 17, filling the sun-drenched atrium with the ethereal sounds of baroque music.

The fall series ends with a roar on November 21 as the Funky Divas raise the roof with what has been described as "highly spirited, energizing, and uplifting" gospel harmonies. Expect your toes to be tapping and hands to be clapping.

<http://eos.sr.unh.edu/About/Events> 